does not rise nor the liquid fall, and the surface of the liquid disappears." Thus the critical point is the temperature when a liquid and its saturated vapour have the same density. From the experiments of Cagniard-Latour he deduces that at the critical point a liquid has no latent heat, and in summing up he says: "At the critical point there is no difference between a liquid and its vapour, neither in tension, nor density, nor thermal constitution, nor appearance, nor any property by which they can be distinguished."

PROF. H. S. CARHART, of Evanston, Ill., has made some researches on the effect on the magnetic field of the rotation of a pierced iron disk in front of the poles of a magnet. The result of this research is that he has found that an iron screen with a hole in it held in front of the pole of a magnet acts magnetically, as a screen with a hole in it held near a light acts optically, the shape of the hole being clearly defined; thus showing the difference of intensity of the field when the iron is there and when it is removed. He has made use of this property by placing a small coil capable of inductive action opposite each pole of a horseshoe magnet; in between the coils and the magnet he rotated a disk of iron with two concentric circles of holes a quarter of an inch in diameter, which came exactly opposite the two poles of the magnet. The inner circle contained thirty-two holes, and the outer contained sixty-four. The two induction bobbins he had connected up with a telephone. When the disk was rotated, he distinctly heard two musical notes produced which were an octave apart. The name given to this instrument is the magnetophone.

MR. E. VAN DER VEN has been making some researches on the use of phosphor bronze and silicon bronze wires for lines, the practical results of which are: that their resistances compared with copper of the same diameter are, phosphor bronze, 30 per cent.; silicon bronze, 70 per cent.; steel being 10·5 per cent. The stretch that can be given from pole to pole is, for steel, 2 mm. diameter, 130 feet; phosphor bronze or silicon bronze, 1 mm. diameter, 106 and 91 feet respectively. Another great point is that a bronze wire, on account of its elasticity, would coil up before it had fallen far if broken, thus preventing accidents from broken wires.

THE GREAT TIDAL WAVE

WE have received several communications on extraordinary tidal phenomena, which seem to be connected with the great earthquake disturbance in Java in August last. We bring these communications together here:—

I have received an interesting letter from Major A. W. Baird, R.E., who directs the Tidal Department of the Survey of India, on the results of the earthquake in Java. The extract from the letter, which I append, speaks for itself. It may be worth mentioning, however, that Negapatam in the Carnatic and Port Blair in the Andaman Islands are nearly in the same latitude and on opposite sides of the Bay of Bengal. It is to be hoped that Major Baird will communicate the results of his investigation to some scientific society in this country.

Trin. Coll., Camb., October 18 G. H. DARWIN

INDIA

Extract from a Letter from A. W. Baird to G. H. Darwin, dated Poona, September 27, 1883

"The wave caused by the volcanic eruption at Java is distinctly traceable on all the tidal diagrams hitherto received, and I am informed of great tidal disturbance at Aden on August 27; but the daily reports are always meagre in information. Kurrachee and Bombay also show the disturbance, and as far as I have examined the wave reached half way up to Calcutta on the Hooghly.

"Negapatam was most disturbed, and at Port Blair there was very great disturbance. I have reports from Port Blair of tremendous noises as if a ship was firing guns as signals of distress, and they sent out a steamer to look about. Similar reports come from the Nicobars, and I see by the papers the noises were heard at Tavoy and Mergui in Burmah.

"I am collating the information and getting up diagrams showing the tide-curves of August 27 and 28, all in Port Blair time, and all on the scale $\frac{1}{12}$. I am of opinion that I can distinctly prove the first wave to be negative, and that it certainly extended to Negapatam, thus showing that there must have been at first an enormous depression or subsidence at the bottom of the sea in the Straits of Sunda.

"By proper handling of the records I hope to deduce the velocity of the wave from Java to Aden, and from Java up the Bay of Bengal. . . . .

"Unfortunately it will take a long time to get the information about the time the wave was generated; but I am leaving no stone unturned to get it. I have sent about twenty circulars to various port officers, and I have asked —— to ask for information from Batavia."

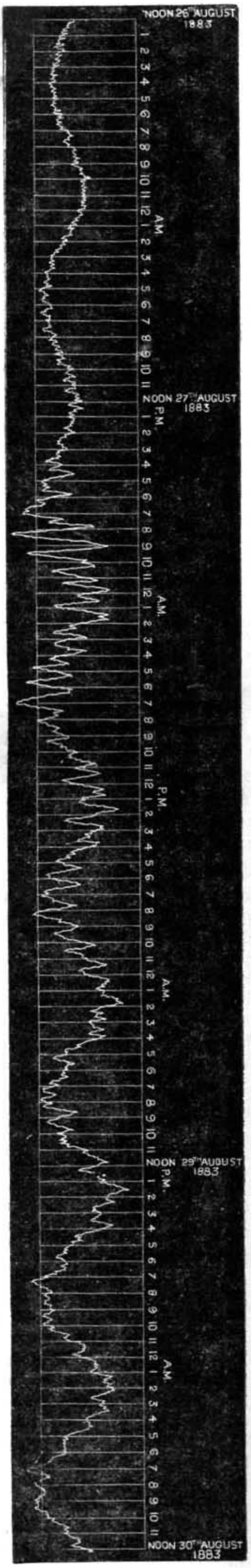
SOUTH AFRICA

Some tidal stations have recently been established, on my recommendation, along the coast of South Africa, and the results obtained from the observations will be ultimately discussed. Meanwhile I inclose herewith a tracing from the tidal diagram at one of these stations (taken at Port Elizabeth under Mr. Shield, harbour engineer), covering the period from noon on August 26 to noon on August 30. It will be seen from the diagram that till 4 p.m. on August 27 the curve was perfectly normal.

At 8 p.m. on August 27 an extraordinary oscillation, having a period of about an hour, commenced, and at 9 p.m. had attained a range of five feet. It then gradually but very slowly subsides.

Mr. Shield thinks, and I agree with him, that the tidal disturbance in question has its origin probably in the recent disturbance in the Straits of Sunda. Our information here is as yet very defective. Accurate data as to that disturbance would be of the greatest interest. DAVID GILL

Royal Observatory, Cape of Good Hope, Sept. 25



The Tidal Wave, South Africa.

MAURITIUS

In the Mauritius *Mercantile Record* of September 8, Mr. C. Meldrum gives a collection of data on the phenomena observed in the neighbourhood of Mauritius. One of the local papers, the *Progrès Colonial*, gave, in its issue of August 29, an account of a curious phenomenon observed in the harbour of Port Louis, by Capt. Ferrat, of the s.s. *Touareg*. The *Touareg* was moored in the Trou Fanfaron, near the Patent Slip. Towards 2 p.m. on August 27 Capt. Ferrat, who was then on board of his vessel, observed that in that part of the harbour the sea

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suddenly receded, leaving the rocks in the neighbourhood dry. The level of the water, it is said, fell to the extent of four or five feet. About a quarter of an hour after, the sea regained its former level with extreme violence, causing the *Touareg* and other vessels to roll frightfully. An alternate lowering and rising of the sea-level continued till 6 p.m. By 7 p.m. all had disappeared. On the morning of the 28th, however, there were still strong currents. In its issue of August 31, the same paper reports that, while traversing the pass between Round Island and the Coin de Mire, on the 27th, a Government boat, though running before a strong breeze, was stopped by a current from the opposite direction, and that the *patron* observed the sea receding precipitately from the vicinity of Gabriel Island, leaving the reefs dry, but that in a few minutes they were, by a sudden reflux, covered with water to the depth of six feet. The *Mercantile Record* of August 30 reported that on the 27th the sea in the Trou Fanfaron went down every twelve minutes, leaving all the boats moored in front of the harbour workshed dry, and then immediately rose again. The *Touareg* and *Stella* seemed to be in a boiling sea. On the 27th the sea in Tombeau Bay suddenly fell five feet below its usual level, and fish were caught on the dry beach. A quarter of an hour later the sea returned and rose nearly five feet above its ordinary level. Similar phenomena were observed at the Morne Brabant. On the same day, remarkable atmospheric and magnetic disturbances were recorded at the Royal Alfred Observatory, Pamplemousses. It would thus appear that from at least Flat Island, about eight miles north of the mainland of Mauritius, to Port Louis on the west coast, and thence round by the Morne to Souillac on the south coast, a distance in all of about forty-six miles, an unusual perturbation occurred with regard to the level and motion of the sea-water, and that on the same day meteorological and magnetic perturbations were recorded at the Observatory. The interest created by these occurrences was heightened by the report that vessels which arrived from the eastward on August 28 had passed through fields of pumice-stone.

Mr. Meldrum then gives a short account of what happened at the Observatory, and relates what has been told him by eye-witnesses of what occurred in the harbour and elsewhere.

1. *Barograms.*—The barogram sheet for the forty-eight hours ending at 8 a.m. on the 28th shows a remarkable disturbance in the atmospheric pressure between 11 a.m. and 5 p.m. on the 27th. Under ordinary conditions the barometer invariably falls from a maximum at about 9.30 a.m. to a minimum at about 3.30 p.m. But on August 27 last this was not the case. Soon after 11 a.m. a slight disturbance began, as indicated by small successive indentations in the barogram. At 11.55 a.m. the mercury stood at 29·996 inches, and at 0.06 p.m. at 29·918; it then rose to 29·961 at 0.20 p.m., after which it fell to 29·916 at 1.10 p.m. From 1.10 to 3.00 p.m. it rose, and at the latter hour stood at 29·968. In the interval from 2.50 to 3.55 p.m. there were five wavelets, and the mean interval between their lowest points was 16 minutes. Upon the whole, however, the mercury continued to rise after 1.10 p.m. The sudden fall from 11.55 a.m. to 0.06 p.m., and the rise from 0.06 to 0.20 p.m., are shown by a projecting peak. This peak, the undulations from 2.50 to 3.55 p.m., and the fact that the minimum occurred fully two hours earlier than usual, are the principal characteristics of the disturbance. After 5 p.m. there was no trace of disturbance.

A smaller disturbance occurred between 9 p.m. and midnight on the 28th.

2. *Magnetograms.*—Towards 9 a.m. on the 27th the north end of the declination magnet began to move towards the west, at first slowly and then more rapidly, and at 11 a.m. it attained its westerly maximum position, the movement since 9 a.m. amounting to 7′ 37″ of arc. An easterly movement then set in, and continued till 0h. 15m. p.m., the north end being then 13′ 18″ east of its position at 11 a.m. A slight westerly movement of 3′ 18″ then occurred up to 1h. 20m., after which there was a rapid movement towards the east till 2 p.m., the decrease in declination since 1h. 20m. being 10′ 37″. The magnet then moved towards the west, recovering its normal position about 5 p.m., and all traces of disturbance ceased. From 10 to 11 a.m., and especially from 11 a.m. to 1 p.m., there were several minor oscillations. The extreme range from the maximum westerly position at 11 a.m. to the maximum easterly position at 2 p.m. was 20′ 43″.

The dip, or vertical force magnetometer, as indicated by the curve, shows traces of disturbance between 8h. 15m. and 11h. a.m. on the 27th. At the latter hour a rapid decrease of force began and continued till 0h. 15m. p.m., the decrease amounting in parts of force to ·00086, and the south end of the magnet moving upward through an angle of 16′ 07″. From 0h. 15m. to 1h. 20m. a slight increase of force took place, amounting to ·00027, the south end of the magnet dipping to the extent of 5′ 06″. After 1h. 20m. a very rapid decrease set in, which continued till 1.50 p.m., the decrease amounting to ·00083, and the south end of the magnet moving upward through an angle of 15′ 38″. The force then gradually increased and recovered its normal value at 6 p.m., by which time it had increased to the extent of ·00104 parts of force since 1h. 50m., the south end of the magnet moving downward through an angle of 19′ 36″. The total decrease from 11 a.m. to 1h. 50m. p.m. was ·00142, during which interval the range of angular movement was 26′ 40″. There were several minor oscillations, particularly between 11 a.m. and 0h. 40m. p.m.

The horizontal force curve also shows a well-marked disturbance, but it was less than in the case of the other curves.

The principal features of these disturbances were the unusually large ranges of the movements of the magnets, and the differences between the epochs of maximum and minimum and the average epochs.

Magnetic disturbances occurred also on August 28 and 29.

Disturbances in the Trou Fanfaron.—Capt. Ferrat states that at some time between 1.30 and 2 p.m. on the 27th the water rushed inwards from the harbour with great violence, and rose above its former level to the extent of fully three feet. An alternate ebb and flow then continued till nearly 7 p.m., the intervals in time between low and high water being about 15 minutes. There was no wave or billow, but a strong current, the estimated velocity of which was about three knots in ten minutes, or eighteen knots an hour. The current appeared to be strongest towards evening. Similar disturbances, but less marked, were observed on the morning of the 28th.

On the opposite side of the Trou Fanfaron another observer noticed, about 2 p.m. on the 27th, that around the *Stella*, which was moored within about 25 yards of him, the water had a "boiling appearance." The water then receded about 20 feet from the shore, leaving some boats near him partly on dry land. About a quarter of an hour after the water rushed back and advanced about six feet farther inland than where it was at 2 p.m. The water then receded, and a series of oscillations took place till about 6 p.m., the intervals between high and low water being from 15 to 20 minutes, and the extent of rise and fall which was at first about three feet, becoming less and less after 4 p.m.

These statements accord with others previously made to the Hon. Mr. Connal.

Similar phenomena, but of a less violent character, occurred between 2.30 and 6 p.m. on the 28th.

The Trou Fanfaron, it may be remarked, is a narrow inlet on the north-east side of the harbour. Near its mouth, or entrance, its direction is south-west and north-east; it then turns towards the east, and throughout the greater part of its length (about 1600 feet) it runs nearly east and west. Its breadth is generally from 200 to 300 feet.

Similar disturbances were observed at Arsenal and Tombeau Bays.

On August 11 and 12 the *Idomene*, in 6° to 8° S., and in 88° E., passed through fields of pumice-stone, which may have been ejected from a volcano near the Straits of Sunda. At all events, that pumice-stone had no immediate connection with what took place in Mauritius.

"I will at present," Mr. Meldrum concludes, "make no attempt to explain the phenomena in question. Magnetic disturbances, properly so-called, are not produced by earthquakes, but are generally ascribed, in a measure at least, to cosmical causes. The disturbances of the magnets on this occasion, however, may have been mechanical effects of earth-waves, although no permanent change of level took place. The difficulty is to refer all the phenomena to the same cause."

THE MOTION OF WATER[1]

1. *Objects and Results of the Investigation.*

THE results of this investigation have both a practical and a philosophical aspect.

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[1] "An Experimental Investigation of the Circumstances which Determine whether the Motion of Water shall be Direct or Sinuous, and of the Law of Resistance in Parallel Channels." Abstract of Paper read at the Royal Society by Prof. Osborne Reynolds, F.R.S.

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